



POWER AND ENERGY



Michigan Chapter
NDIA
National Defense Industrial Association

P & E Innovation Workshop Outbrief

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- NDIA sponsored Power and Energy Innovation Workshop (July 7-9, 2009)
 - Attended by Government, industry and academic experts
 - Hosted by TARDEC in collaboration with TRADOC and Office of the Deputy Chief of Staff of the Army
- **Provide possible future power and energy solutions** for Army soldier, ground vehicle, aerial vehicle and installation needs

- Successful execution of the United States Army mission requires effective deployment and management of:



Ground Vehicles



Aerial Vehicles



Installations



Soldier

- Unique requirements and challenges
- Articulate power and energy requirements
- Outline efficient technologies
- Reduce energy use to optimize future force effectiveness

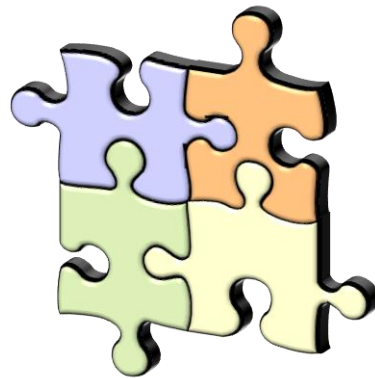
Global Problem Statement

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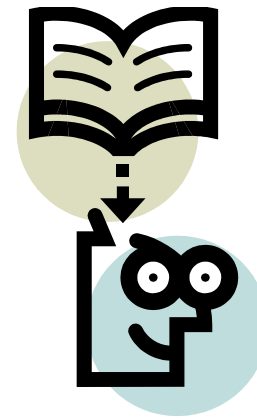
- Power and Energy are greatest enabler of warfighter capability



No Silver Bullet



Integrated Suite of Technologies



Education, Training and Awareness



- Key Themes:
 - **Demand** needs to be understood and reduced
 - **Electricity** is the medium for power distribution near to med-term
 - Long term: **multi-fuel sources** (incl. solar, solids, liquids, etc...)
 - **Optimize** the system, not the individual components
- Requirements:
 - **Use** of a globally available fuel source
 - **Increased** power density/higher energy conversion efficiency
 - **Reduce** parasitic loads
- Constraints:
 - **Fuel** requirements (variability, specification)
 - **Nuclear** (shielding, cooling)
 - **Waste Energy Recovery** (temp, materials)
 - **Propulsion** (ability to use commercial equip is declining)



- Key Take Away
 - Tightening or modification of JP8 specifications is needed
 - Propulsion systems need certification on broader range of fuels
 - Start exploring the application of WER
 - Grid integration could be phased in as technology advances
 - Nuclear is not feasible for today's GV applications
 - Fuel cells are feasible for APUs and applications under 1kW



- Key Themes:
 - **Engines** are key, but rotors/airframe/trans need to be addressed
 - Continue system/component investment for **optimized design**
 - **Mission based profiles** for evaluation of systems/components
- Requirements:
 - **Increase** power capability and fuel efficiency
 - **Reduce** operating and sustainment costs
 - **Explore** alternative fuels
 - **Reduce** air vehicle noise and signature
- Constraints:
 - **Fuels** (lubricity effects on seals, varnishing of injector nozzles)
 - **Hybrid** (Operating voltage, waste heat management)
 - **“More Electric”** (Power to weight ratio, EMI, reliability)
 - Increasing **Payload** (weapon, fuel, sensors, equipment)



Aerial Vehicle Session (continued)

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- Key Take Away
 - Hybrids* are promising technology for future applications
 - “More Electric” tech promises reduced parasitic engine losses
 - i.e. Nutating, bonner, diesel rotary engines
 - No major roadblocks with alternative fuel use
 - Promising new engine technologies for small aircraft
 - No foreseeable engine technology likely to surpass Brayton cycle (turbine) for large (500+hp) applications

* Hybrid in aerial context means: turbine with any form of electrical, chemical or mechanical power augmentation



- Key Themes:
 - **Single Joint Solution** needed for all services in theater camps
 - Must first address how each **soldier views and values** energy
 - **Smart grid technology** is solution that could be utilized today
- Requirements:
 - **Reduce/replace** generators (30%<fuel by 2015, replace by 2030)
 - New energy sources to **minimize/replace** hydrocarbon sources
 - **Use** expeditionary power grids for recharging batteries/fuel cells
 - **Achieve** NetZero installations by 2030
- Constraints:
 - **No one agency** is lead for power/energy for installation/theater
 - **Metrics** must be used to ensure improvements are saving energy
 - 5 year waiting period: **MILCON**
 - There is no **standardization** of theater camps



- Key Take Away
 - Efficient HVAC/ECU's for installations/theater camps by 2014
 - Modeling/simulation is a key tool for infrastructure design
 - New systems must not drastically effect end-user processes and procedures
 - Improved biofuel process needed to be competitive replacement
 - Nuclear use in-camp limited by security and logistics, possible wide-spread use in fixed installations



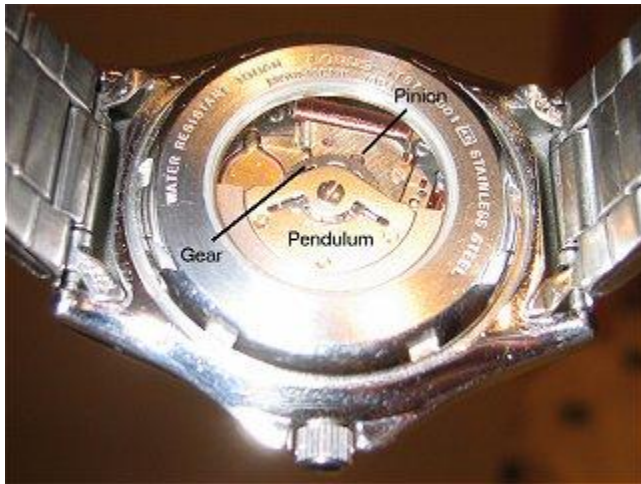
- Key Themes:
 - Use **high energy density** choices available today
 - All future equipment needs **smart energy management** tech
 - **Power/energy profiles** must be matched with mission profile
 - **System level design** needed to achieve max effectiveness
- Requirements:
 - **Base** equipment strategies on human requirements
- Constraints:
 - **Energy Storage Std**s (connectors, form, voltage, high/low temp)
 - **Energy Harvesting** (random pulses into energy, low watt gain)
 - **Fueled Systems** (efficiencies, power and energy densities)
 - **Nuclear** (low conversion efficiency and power production, Soldier and public safety perception issues)



- Key Take-Away
 - Movement toward rechargeable energy storage solutions
 - Energy harvesting will require technological breakthroughs and major cost reductions before use feasible
 - Fuel cells are likely answer to the high-value mission soldier-worn equipment and applications
 - Nuclear power generation (beta decay) is relevant for long-term, low power applications such as sensors and sleep mode operations

Soldier Session (continued)

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kinetic watch movement



Robot

340 lbs payload

(Not representative of load capacity)



Personal Fuel Cell

Workshop Next Steps

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- Future workshops needed for deep-dive look into technology timeline/solutions
- Work with Air Force and Generals Stevenson and Vane to influence industry fuel specifications (*now is the time*)
- Create innovation priority list aligned with “War Fighter Outcomes”
- Develop mission-based energy consumption profiles for developing and testing of new technologies